Worksheet: Balancing Equations
Part 1

1. ___$KClO_3$ → ___KCl + O_2

2. ___HgO → ___Hg + ___O_2

3. ___H_2O_2 → ___H_2O + ___O_2

4. ___Cu + ___O_2 → ___CuO

5. ___Fe + ___ HCl → ___ $FeCl_2$ + ___H_2

6. ___Mg + ___N_2 → ___ Mg_3N_2

7. ___Zn + ___H_2SO_4 → ___$ZnSO_4$ + ___H_2

8. ___C + ___O_2 → ___CO_2

9. ___ Na + ___HOH → ___NaOH + ___H_2

10. ___BaO_2 + ___H_2SO_4 → ___$BaSO_4$ + ___H_2O_2

11. ___$NaClO_3$ → ___NaCl + ___O_2

12. ___$BaCl_2$ + ___K_3PO_4 → ___$Ba_3(PO_4)_2$ + ___KCl

13. ___Fe + ___H_2O → ___Fe_3O_4 + ___H_2

Part II

1. zinc + silver nitrate → zinc nitrate + silver

2. barium chloride + sodium sulfate → barium sulfate + sodium chloride

3. copper + sulfur → copper(I) sulfide

4. magnesium + sulfuric acid(hydrogen sulfate) → magnesium sulfate + hydrogen gas

5. silver nitrate + ammonium chloride → ammonium nitrate + silver chloride

6. potassium + water → potassium hydroxide + hydrogen gas

7. hydrogen + copper(II) oxide → water + copper

8. calcium + water → calcium hydroxide + hydrogen gas

9. aluminum + hydrogen chloride(hydrochloric acid) → aluminum chloride + hydrogen gas

Worksheet: Balancing Equations

1. calcium + oxygen → calcium oxide

2. phosphorus + chlorine → phosphorus(III) chloride

3. phosphorus + chlorine → phosphorus(V) chloride

4. potassium chlorate $\xrightarrow{\Delta}$ potassium chloride + oxygen

5. iron(III) hydroxide $\xrightarrow{\Delta}$ iron(III) oxide + water

6. hydrogen nitrite(nitrous acid) $\xrightarrow{\Delta}$ hydrogen nitrate(nitric acid) + nitrogen monoxide + water

7. nitrogen(V) oxide + water → nitric acid

8. sodium oxide + water → sodium hydroxide

9. aluminum hydroxide + hydrogen chloride → aluminum chloride + water

10. manganese(IV) oxide + hydrogen chloride(hydrochloric acid) → manganese(III) chloride + water + chlorine

11. iron(III) chloride + hydrogen sulfide → iron(II) chloride + hydrogen chloride + sulfur

12. potassium dichromate + nitrogen dioxide + nitric acid → potassium nitrate + chromiun(III) nitrate + water

13. sulfur + oxygen → sulfur dioxide

14. nitrogen + hydrogen → ammonia

15. hydrogen + chlorine → hydrogen chloride

16. mercury(II) oxide $\xrightarrow{\Delta}$ mercury + oxygen

17. nickel(II) chlorate $\xrightarrow{\Delta}$ nickel(II) chloride + oxygen

18. aluminum + hydrogen sulfate(sulfuric acid) → aluminum sulfate + hydrogen

19. potassium iodide + chlorine → potassium chloride + iodine

20. silver nitrate + copper → copper(II) nitrate + silver

Reaction Word Scramble

Use the words provided to help unscramble the letters below to form words related to Chapter 3. The letters in the circles spell out the name of an element.

Clues

1. Energy-releasing action
2. Energy-absorbing action
3. Reaction involving formation of a more complex product
4. Commonly occurring compound
5. Kind of replacement reaction
6. Reaction involving formation of a less complex product
7. Another kind of replacement reaction
8. Remains constant during a reaction

1. XOEEHMCTIR ____○_____
2. IDOHRCNTEME _____○_
3. NHISEETYSS ____○_____
4. AERWT _○____
5. ENLSGI __○___
6. NTDOOCPSEMIIO _____○_____
7. DLOEUB __○___
8. SASM ○___

Name of Element: _____

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4 Types of Reactions

1. Composition(synthesis)

$A + X \rightarrow AX$ (check charges!!!)

a) metal + nonmetal or metalloid → compound
b) metal + nonmetal → compound
c) metal oxide + water → hydroxide (base) ----OH
d) nonmetal oxide + water → acid H----

2. Decomposition (analysis)

$AX \rightarrow A + X$

a) metallic carbonate $\xrightarrow{\Delta}$ metal oxide + CO_2
b) metallic hydroxide $\xrightarrow{\Delta}$ metal oxide + H_2O
c) metallic chlorate $\xrightarrow{\Delta}$ metal chloride + O_2
d) Some acids $\xrightarrow{\Delta}$ nonmetal oxide + H_2O
e) Some oxides $\xrightarrow{\Delta}$ decompose

$2HgO \rightarrow 2Hg + O_2$

f) Some decomposition reactions are produced by an electric current

$2H_2O \xrightarrow{\text{electricity}} 2H_2 + O_2$

D.C.

3. Single Replacement Note: Use Activity Series Chart

$A + XY \longrightarrow X + AY$ OR $A + XY \longrightarrow XA + Y$

a) replace a metal in a compound by a more active metal
b) replace hydrogen in water by an active metal.
Exceptions: Li, K, Ca, Na are so active that they form hydroxides instead of oxides
c) replace hydrogen in an acid by an active metal
d) replace a halogen by a more active halogen

4. Double Replacement

$AB + XY \longrightarrow AY + XB$

Note: Use Solubility Chart

a) salt + salt ⇄ salt + salt
b) salt + base → salt + base
c) salt + acid → salt + acid
d) acid + base → salt + water

Note: a salt is a positive ion from a base and a negative ion from an acid

Table 11.
SOLUBILITIES

S = soluble in water. A = soluble in acids, insoluble in water. P = partially soluble in water, soluble in dilute acids. I = insoluble in dilute acids and in water. a = slightly soluble in acids, insoluble in water. d = decomposes in water.

	acetate	bromide	carbonate	chlorate	chloride	chromate	hydroxide	iodide	nitrate	oxide	phosphate	silicate	sulfate	sulfide
aluminum	S	S	—	S	S	—	A	S	S	a	A	I	S	d
ammonium	S	S	S	S	S	S	—	S	S	—	S	—	S	S
barium	S	S	P	S	S	A	S	S	S	S	A	S	a	d
calcium	S	S	—	S	S	S	A	S	S	—	P	P	P	P
copper(II)	S	S	—	S	S	—	—	—	S	A	A	A	S	A
hydrogen	S	S	—	S	S	—	—	—	S	—	I	I	S	A
iron(II)	S	S	P	S	S	A	A	S	S	A	—	—	S	d
iron(III)	S	S	—	S	S	S	P	S	S	A	A	A	P	A
lead(II)	S	S	A	S	S	P	A	P	S	P	P	I	P	d
magnesium	S	S	P	S	S	P	A	S	S	A	A	—	S	A
manganese(II)	S	S	A	S	S	S	—	S	S	P	A	—	P	d
mercury(I)	P	A	—	S	a	P	A	P	S	A	A	—	S	A
mercury(II)	S	S	S	S	S	S	—	S	S	P	S	—	S	I
potassium	S	a	A	S	S	P	S	I	S	S	S	—	A	I
silver	P	S	S	S	a	S	—	S	S	A	A	—	—	S
sodium	S	S	P	S	S	P	S	S	S	P	A	—	—	A
strontium	S	S	—	S	S	S	A	S	S	A	—	—	—	S
tin(II)	d	S	—	S	S	A	P	d	d	P	—	—	—	S
tin(IV)	S	S	—	S	S	P	A	S	—	P	A	A	S	A
zinc	S	S	P	S	S	P	A	S	S	P	A	A	S	A

Table 8-1.
ACTIVITY SERIES OF THE ELEMENTS

Metals	*Nonmetals*
lithium	fluorine
potassium	chlorine
calcium	bromine
sodium	iodine
magnesium	
aluminum	
zinc	
chromium	
iron	
nickel	
tin	
lead	
hydrogen	
copper	
mercury	
silver	
platinum	
gold	

Appendix D Table of Solubilities of Inorganic Compounds in Water

This table of solubilities is discussed in Section 16-9.

TABLE OF SOLUBILITIES IN WATER

i—nearly insoluble
ss—slightly soluble
s—soluble
d—decomposes
n—not isolated

	acetate	bromide	carbonate	chloride	chromate	hydroxide	iodide	nitrate	phosphate	sulfate	sulfide
Aluminum	ss	s	n	s	n	i	s	s	i	s	d
Ammonium	s	s	s	s	s	s	s	s	s	s	s
Barium	s	s	i	s	i	s	s	s	i	i	d
Calcium	s	s	i	s	s	ss	s	s	i	ss	d
Copper(II)	s	s	i	s	i	i	n	s	i	s	i
Iron(II)	s	s	i	s	n	i	s	s	i	s	i
Iron(III)	s	s	n	s	i	i	n	s	i	ss	d
Lead	s	ss	i	ss	i	i	ss	s	i	i	i
Magnesium	s	s	i	s	s	i	s	s	i	s	d
Mercury(I)	ss	i	i	i	ss	n	i	s	i	ss	i
Mercury(II)	s	ss	i	s	ss	i	i	s	i	d	i
Potassium	s	s	s	s	s	s	s	s	s	s	s
Silver	ss	i	i	i	ss	n	i	s	i	ss	i
Sodium	s	s	s	s	s	s	s	s	s	s	s
Zinc	s	s	i	s	s	i	s	s	i	s	i

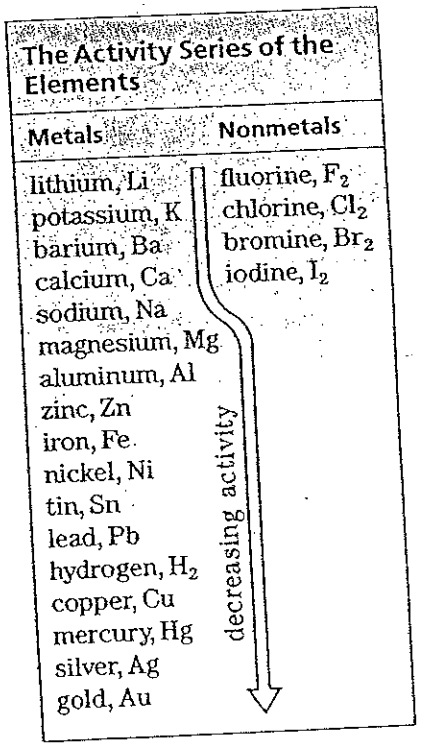

Figure 9-21
How some of the elements rank according to activity.

Name _____ Date _____ Class _____

CHAPTER 9 REVIEW ACTIVITY

Text Reference: **Section 9-12**

Categories of Chemical Reactions

State whether each of the following equations represents a synthesis (s), analysis (a), single replacement (sr), or double replacement (dr) reaction.

1. $CO_2 \rightarrow C + O_2$ — 1. _____
2. $NaCl + AgNO_3 \rightarrow NaNO_3 + AgCl$ — 2. _____
3. $S + Cl_2 \rightarrow SCl_2$ — 3. _____
4. $BaCl_2 + 2NaOH \rightarrow 2NaCl + Ba(OH)_2$ — 4. _____
5. $Zn + CuSO_4 \rightarrow ZnSO_4 + Cu$ — 5. _____
6. $CH_4 \rightarrow C + 2H_2$ — 6. _____
7. $Pb(NO_3)_2 + Mg \rightarrow Pb + Mg(NO_3)_2$ — 7. _____
8. $Mg + 2HCl \rightarrow MgCl_2 + H_2$ — 8. _____
9. $H_2SO_4 \rightarrow H_2 + S + 2O_2$ — 9. _____
10. $2O_2 + N_2 \rightarrow N_2O_4$ — 10. _____
11. $3CaBr_2 + 2Na_3P \rightarrow Ca_3P_2 + 6NaBr$ — 11. _____
12. $2KI + Br_2 \rightarrow 2KBr + I_2$ — 12. _____
13. $C_6H_{12}O_6 \rightarrow 6C + 6H_2O$ — 13. _____
14. $2NaF \rightarrow 2Na + F_2$ — 14. _____
15. $Si + O_2 \rightarrow SiO_2$ — 15. _____
16. $2NaI + Pb(NO_3)_2 \rightarrow 2NaNO_3 + PbI_2$ — 16. _____
17. $NaI + Cs \rightarrow CsI + Na$ — 17. _____
18. $H_2 + CO + O_2 \rightarrow H_2CO_3$ — 18. _____
19. $Li_3PO_4 \rightarrow 3Li + P + 2O_2$ — 19. _____
20. $CS_2 + 2F_2 \rightarrow CF_4 + 2S$ — 20. _____

Name Date

* Balancing Equations and Identifying Types of Reactions *

1. Balance the following equations
2. State whether they are: composition, decomposition, single or double replacement Reactions

1. ___CuO + ____H_2 ----> _____Cu + _____H_2O

2. ____Sb + ___ H_2O ---> _____Sb_2O_3 + _____H_2

3. ____Re + ____Br_2 ------> ____$ReBr_3$

4. ____$Ac(OH)_3$ ----> ____Ac_2O_3 + _____H_2O

5. _____Ra + _____O ----> _____RaO_2

6. _____NH_4NO_2 ----> _____H_2O + _____N_2

7. _____Cu + _____S_8 ----> _____Cu_2S

8. _____$AgNO_3$ + _____H_2SO_3 ----> ____Ag_2SO_4 + _____HNO_3

9. _____NH_4NO_3 ----> _____H_2O + _____N_2O

10. _____$CuCO_3$ ----> _____CuO + _____CO_2

Worksheet: Combustion Reactions

a) Write the equation for the combustion of the following organic compounds
b) Balance the equation
c) Put arrows where appropriate

1. Propane (C_3H_8)

2. Ethylene (C_2H_4)

3. Octane ($C_8H_{18}(l)$)

4. Methane (CH_4)

5. Acetylene (C_2H_2)

6. Heptane (C_7H_{16})

7. Butane (C_4H_{10})

Single Replacement Reactions

a) replace words with symbols and indicate gases with arrows up
b) predict reaction or NR
c) balance equation

1. calcium + water →

2. iron(II) + copper(II) nitrate →

3. zinc + hydrochloric acid →

4. chlorine + sodium bromide →

5. copper(II) + water →

6. bromine + potassium iodide →

7. iron(II) + sulfuric acid →

8. silver + sulfuric acid →

9. bromine + potassium chloride →

10. sodium + water →

11. aluminum + water →

12. silver + hydrochloric acid →

13. chlorine + sodium iodide →

14. bromine + potassium fluoride →

15. magnesium + iron(II) nitate →

Double Replacement

a) replace words with symbols
b) predict reaction or NR
c) indicate precipitate with arrow down and gases with an arrow up
d) balance equation

1. silver nitrate + sodium chloride →

2. lead(II) nitrate + potassium iodide →

3. potassium chloride + sulfuric acid(hydrogen sulfate) →

4. sodium bromide + phosphoric acid(hydrogen phosphate) →

5. silver acetate + potassium chlorate →

6. potassium hydroxide + hydrogen chloride(hydrochloric acid) →

7. zinc chloride + sulfuric acid →

8. calcium phosphate + sodium nitrate →

9. sodium hydroxide + aluminum chloride →

10. barium nitrate + sulfuric acid →

11. sodium hydroxide + copper(II) sulfate →

12. sodium hydroxide + hydrogen nitrate(nitric acid) →

13. silver acetate + potassium chloride →

14. calcium phosphate + sodium nitrate →

15. cupric chloride + ammonium sulfide →

5D

Mixed: Single and Double Replacement
a) replace words with symbols
b) predict reaction or NR
c) indicate precipitates with an arrow down and gases with an arrow up
d) balance equations
e) state if the reaction is single or double

1. zinc + hydrochloric acid ⟶

2. bromine + potassium chloride ⟶

3. calcium hydroxide + hydrogen phosphate ⟶

4. aluminum sulfate + calcium hydroxide ⟶

5. calcium + hydrochloric acid ⟶

6. silver + lead(II) acetate ⟶

7. iron(II) sulfide + hydrochloric acid ⟶

8. aluminum + nickel(II) nitrate ⟶

9. silver nitrate + zinc chloride ⟶

10. copper(II) + calcium carbonate ⟶

Composition Reactions
a) replace words with symbols
b) predict reactions and indicate gases with arrows up
c) balance equations

1. sulfur trioxide + water →

2. sodium + oxygen →

3. magnesium oxide + water →

4. hydrogen + bromine →

5. carbon + oxygen →

6. copper(II) + chlorine →

7. nitrogen(III)oxide + water →

8. potassium oxide + water →

9. carbon dioxide + water →

10. barium oxide + water →

11. zinc + sulfur →

12. sodium oxide + water →

13. potassium + chlorine →

14. hydrogen + chlorine →

15. nitrogen + hydrogen →

50

Decomposition Reactions
a) replace the words with symbols and gases with an arrow up
b) predict reaction
c) balance equation

1. lithium carbonate $\xrightarrow{\Delta}$

2. iron(III) hydroxide $\xrightarrow{\Delta}$

3. nickel(II) chlorate $\xrightarrow{\Delta}$

4. carbonic acid(hydrogen carbonate) $\xrightarrow{\Delta}$

5. silver oxide $\xrightarrow{\Delta}$

6. sodium chloride $\xrightarrow[\text{D.C.}]{\text{electricity}}$

7. barium carbonate $\xrightarrow{\Delta}$

8. zinc hydroxide $\xrightarrow{\Delta}$

9. sulfurous acid(hydrogen sulfite) $\xrightarrow{\Delta}$

10. mercury(II) hydroxide $\xrightarrow{\Delta}$

11. sodium chlorate $\xrightarrow{\Delta}$

12. sulfuric acid (hydrogen sulfate) $\xrightarrow{\Delta}$

13. magnesium bromide $\xrightarrow[\text{D.C.}]{\Delta}$

14. carbonous acid(hydrogen carbonite) $\xrightarrow{\Delta}$

15. calcium hydroxide $\xrightarrow{\Delta}$

Mixed: Composition and Decomposition Reactions
a) replace words with symbols and indicate gases with arrows up
b) predict reaction
c) balance equation
d) state if the reaction is composition or decomposition

1. calcium carbonate $\xrightarrow{\Delta}$

2. phosphorous(III) + chlorine $\longrightarrow$

3. sodium + oxygen $\longrightarrow$

4. silver oxide $\xrightarrow{\Delta}$

5. magnesium + oxygen $\longrightarrow$

6. iron(III) + oxygen $\longrightarrow$

7. cadmium carbonate $\xrightarrow{\Delta}$

8. lead(II) hydroxide $\xrightarrow{\Delta}$

9. iron(II) + sulfur $\longrightarrow$

10. magnesium + nitrogen $\longrightarrow$

11. carbonic acid $\xrightarrow{\Delta}$

Mixed: All 4 Types
a) replace words with symbols
b) predict reaction or NR
c) show precipitates with arrows down and gases with arrows up
d) balance equations
e) State what type of reaction: comp, decom, single, double

1. copper(II) oxide + hydrogen $\longrightarrow$ copper + water

2. antimony + water $\longrightarrow$ antimony(III) oxide + hydrogen

3. rhenium + bromine $\longrightarrow$ rhenium(III) bromide

4. actinium(III) hydroxide $\xrightarrow{\Delta}$ actinium oxide + water

5. radium + carbon $\longrightarrow$ RaC_2

6. ammonium nitrite $\xrightarrow{\Delta}$ water + nitrogen

7. copper + sulfur $\longrightarrow$ copper(I) sulfide

8. silver nitrate + sulfuric acid $\longrightarrow$ silver sulfate + nitric acid(hydrogen nitrate)

9. ammonium nitrate $\xrightarrow{\Delta}$ water + dinitrogen monoxide

10. copper(II) carbonate $\xrightarrow{\Delta}$ copper(II) oxide + carbon dioxide

Mixed: All 4 Types of Reactions
a) replace words with symbols
b) predict reaction or NR
c) indicate precipitates with an arrow down or gases with an arrow up
d) balance equation
e) state the type of reaction: comp, decomp, single, decomp

1. potassium oxide + water $\longrightarrow$

2. silver nitrate + zinc chloride $\longrightarrow$

3. sulfurous acid(hydrogen sulfite) $\xrightarrow{\Delta}$

4. copper(II) + calcium carbonate $\longrightarrow$

5. carbondioxide + water $\longrightarrow$

6. sodium + water $\longrightarrow$

7. iron(II) sulfide + hydrochloric acid $\longrightarrow$

8. mercury(II) hydroxide $\longrightarrow$

9. sodium chloride $\xrightarrow[\text{electricity}]{\Delta}$

10. chlorine + sodium bromide $\longrightarrow$

20

Worksheet: All 4 Types

Come up with a balanced equation to represent the follwing:

1. A S.R. rxn that produces a base

2. A D.R. rxn to produce two insoluble products

3. A compositon(synthesis) rxn to produce an acid

4. A S.R. rxn to produce magnesium

5. A composition rxn to produce sulfuric acid(hydrogen sulfate)

6. A decomposition rxn to produce potassium chloride

7. A D.R. rxn whose products are both soluble

8. A D.R. rxn to produce water

9. A S.R. rxn to produce a halogen gas

10. Any rxn which will change red litmus paper to blue

Double Replacement Chemical Reactions

Purpose: In this laboratory exercise you will combine seven different chemicals. You will observe any evidence that a chemical reaction has occurred and write the chemical equation for those chemical reactions. You will also use the solubility chart to predict whether or not a chemical reaction has occurred and any precipitates that may be formed.

Procedure:

1. Mix seven chemicals in the 21 combinations listed on these sheets.
2. Record any observations that you make during the reaction
3. Write a balanced chemical equation for the reaction. Be sure to indicate precipitates and states of matter
4. Mix the 7 known chemicals with the 1 unknown chemical that your teacher gives you. Identify the unknown chemical by using the data from # 2 above.

Chemicals	Formula
1. Hydrochloric acid	
2. Sodium Hydroxide	
3. Copper II Sulfate	
4. Sodium Carbonate	
5. Silver Nitrate	
6. Potassium [redacted]chromate	
7. Iron III Chloride	

Chemical Equation	Observations
1-2	
1-3	
1-4	
1-5	
1-6	
1-7	
2-3	
2-4	
2-5	
2-6	
2-7	
3-4	
3-5	
3-6	
3-7	

Chemical Equation **Observations**

4-5

4-6

4-7

5-6

5-7

6-7

Unknown Observations

Unknown & 1

Unknown & 2

Unknown & 3

Unknown & 4

Unknown & 5

Unknown & 6

Unknown & 7

IDENTITY OF THE UNKNOWN :

Conclusion: Use the back of this paper to write a conclusion to the lab. Detail what you have learned from the lab. How to predict a double replacement reaction, use a solubility chart, etc. Also, how you determined your unknown using specific observations and details from the lab.

Lab #5: Relative Reactivity of Metals

Introduction:

The relative reactivity of a group of metals can be established by comparing the reaction of each metal with a given reagent. A metal might react with a specific reagent or no reaction may occur. On the other hand, a given metal might react with a specific reagent at a different rate than some other metal. *(H.A. Neidig and J.N. Spencer, Lebanon Valley College, Annville, PA)*

Standards:

3.1.10C Apply patterns as repeated processes or recurring elements in science and technology
3.2.10C Apply elements of scientific inquiry to solve problems
3.4.10A Explain concepts about the structure and properties of matter
3.4.10B Apply appropriate instrument and apparatus to examine a variety of objects and processes

Materials:

Test tube	6 unknown metals
Test tube brush	6M HCl
Test tube rack	0.5M $ZnSO_4$
Barnes dropping bottle	0.5M $MgSO_4$
Steel wool	0.5M $CuSO_4$

Procedure:

1. Put approximately 5 mL (one good squirt) of your first reagent in a test tube.
2. Clean the first metal sample with steel wool and place the clean metal in the test tube with the reagent.
3. Look what happens. Record your observations in the data table. What do you see? Hear? Smell? How does the test tube feel? Is it warm? Is it cold? What does this mean about the reaction?
4. Wait for approximately 1 minute, if nothing occurs, you can assume that a reaction will not take place.
5. Fill your test tube (containing the reagent and metal) with water and dump the contents into the sink. Be sure to catch the metal so it does NOT go down the drain. Rinse the test tube three additional times using a test tube brush. The test tube must be completely clean before you continue with the next reagent.
6. Repeat the process with the remaining reagents.
7. When you are finished with each the reagents, repeat the procedures with your next unknown metal.

IMPORTANT SAFETY INFORMATION:

6M HCl is VERY dangerous and causes burns. Please take extra precautions NOT to spill the reagent. If you do spill, you MUST tell the teacher so it can be cleaned up properly!!!

Discussion Topics:

1. Write equations for each of the reactions that took place.
2. Based on your observations, rank the metals in order of increasing activity.
3. A student did not follow the instructions when doing this experiment. Instead of using a new portion of $CuSO_4$, he used the final reaction mixture from the addition of magnesium to $CuSO_4$ solution to which was added to a strip of zinc. The student reported that the zinc did not react with the $CuSO_4$ solution. What explanation might be given to account for this observation? Prove by writing the appropriate equations.
4. A student was given four metals, A, B, C, and D, and solutions of their corresponding salts, AZ, BZ, CZ, and DZ. The student was asked to determine the relative reactivity of the four metals by reacting the metals with the solutions. The results of the laboratory observations of a student are as follows:

Metal	AZ	BZ	CZ	DZ
A	N	N	N	N
B	R	N	R	N
C	R	N	N	N
D	R	R	R	N

R = reaction; N = no reaction

Rank the metals in order of increasing reactivity.

50

Reactivity of Metals Data Table

METAL	REAGENT	OBSERVATIONS
A	HCl	
B	HCl	
C	HCl	
D	HCl	
E	HCl	
F	HCl	
A	$ZnSO_4$	
B	$ZnSO_4$	
C	$ZnSO_4$	
D	$ZnSO_4$	
E	$ZnSO_4$	
F	$ZnSO_4$	
A	$MgSO_4$	
B	$MgSO_4$	
C	$MgSO_4$	
D	$MgSO_4$	
E	$MgSO_4$	
F	$MgSO_4$	
A	$CuSO_4$	
B	$CuSO_4$	
C	$CuSO_4$	
D	$CuSO_4$	

METAL	REAGANT	OBSERVATIONS
E	$CuSO_4$	
F	$CuSO_4$	

	color	texture	luster
A			
B			
C			

	color	texture	luster
D			
E			
F			

I. Title: Reactivity of Metals

II. Purpose: use complete sentences

III. Pre Lab Assignment

IV. Data: Get It Signed!!!!!

	color	texture	luster
Mg			
Zn			
Cu			

Equations:

$Mg + HCl \rightarrow$

$Zn + HCl \rightarrow$

$Cu + HCl \rightarrow$

$Mg + MgSO_4 \rightarrow$

$Zn + MgSO_4 \rightarrow$

$Cu + MgSO_4 \rightarrow$

$Mg + ZnSO_4 \rightarrow$

$Zn + ZnSO_4 \rightarrow$

$Cu + ZnSO_4 \rightarrow$

$Mg + CuSO_4 \rightarrow$

$Zn + CuSO_4 \rightarrow$

$Cu + CuSO_4 \rightarrow$

Observations:

V. Analysis Questions #1 to #6
Note: For #2,4,and 6, put in order from strongest to weakest

VI Conclusion: 3 paragraphs(sentence form)
Summarize procedur, Tell me what you learned, How do you know you accomplished the purpose?

I. Title: Reactivity of Metals

II. Purpose: use complete sentences

III. Pre Lab Assignment

IV. Data: Get It Signed!!!!!

	color	texture	luster
A			
B			
C			

	color	texture	luster
D			
E			
F			

Equations:

Observations:

V. Analysis Questions #1 to #6
Note: For #2,4,and 6, put in order from strongest to weakest

VI Conclusion: 3 paragraphs(sentence form)
Summarize procedur, Tell me what you learned, How do you know you accomplished the purpose?

Relative Reactivity of a Group of Metals: Observations

Metal	6M HCl	0.5M $ZnSO_4$	0.5M $MgSO_4$	0.5M $CuSO_4$
A				
B				
C				
D				
E				
F				

EQUATION DRILL

Write a balanced chemical equation for each of the reactions indicated below:

I. SYNTHESIS OR DIRECT COMBINATION

1. Iron + sulfur
2. Phosphorus + oxygen
3. Carbon dioxide + water
4. Sulfur + oxygen
5. Zinc + oxygen
6. Mercury + oxygen
7. Sulfur dioxide + water
8. Aluminum + oxygen
9. Copper + sulfur
10. Iron + oxygen
11. Zinc + sulfur
12. Hydrogen + chlorine
13. Calcium oxide + water
14. Sodium + oxygen
15. Antimony + chlorine

II. ANALYSIS OR DECOMPOSITION

1. Decomposition of mercuric oxide by heat
2. Laboratory preparation of oxygen by heating potassium chlorate
3. Electrolysis of water
4. Heating of sodium chlorate
5. Electrolysis of molten sodium chloride
6. Electrolysis of molten potassium chloride
7. Electrolysis of molten magnesium chloride
8. Electrolysis of molten aluminum oxide
9. Electrolysis of molten calcium chloride
10. Heating carbonic acid (H_2CO_3), yielding water and carbon dioxide
11. Heating ammonium hydroxide (NH_4OH), yielding ammonia gas and water
12. Heating sulfurous acid (H_2SO_3), yielding sulfur dioxide and water
13. Electrolysis of molten barium chloride
14. Heating calcium hydroxide, yielding calcium oxide and water
15. Heating calcium carbonate, yielding calcium oxide and carbon dioxide

III. SINGLE REPLACEMENT

1. Zinc + sulfuric acid
2. Zinc + hydrochloric acid
3. Iron + sulfuric acid
4. Iron + hydrochloric acid
5. Zinc + phosphoric acid
6. Aluminum + hydrochloric acid

7. Magnesium + sulfuric acid
8. Sodium + water
9. Potassium + water
10. Calcium + water
11. Copper oxide + hydrogen
12. Ferric oxide + hydrogen
13. Lead oxide + hydrogen
14. Magnesium + hydrochloric acid
15. Aluminum + sulfuric acid

IV. DOUBLE REPLACEMENT

1. Sodium hydroxide + hydrochloric acid
2. Sodium hydroxide + sulfuric acid
3. Sodium hydroxide + phosphoric acid
4. Ammonium hydroxide + sulfuric acid
5. Calcium hydroxide + nitric acid
6. Calcium hydroxide + phosphoric acid
7. Calcium hydroxide + sulfuric acid
8. Potassium hydroxide + hydrochloric acid
9. Silver nitrate + hydrochloric acid
10. Silver nitrate + ferric chloride
11. Silver nitrate + cupric chloride
12. Ferrous sulfide + hydrochloric acid
13. Ammonium hydroxide + phosphoric acid
14. Barium chloride + sulfuric acid
15. Barium chloride + ammonium sulfate

V. MISCELLANEOUS

After writing each of the following equations, indicate by means of the proper letter to what general type it belongs, as follows:

S = Synthesis (Direct Combination)
A = Analysis (Decomposition)
R = Single Replacement
D = Double Replacement

1. burning hydrogen
2. aluminum + hydrochloric acid
3. magnesium + phosphoric acid
4. carbon dioxide + water
5. silver nitrate + ferrous chloride
6. calcium bromide + chlorine
7. aluminum hydroxide + nitric acid
8. burning carbon
9. phosphorus + oxygen
10. ferric oxide + carbon
11. zinc + oxygen
12. aluminum + oxygen
13. burning magnesium
14. calcium + water

Chemical Changes and Equations 5

There are many ways to detect or "observe" a chemical change — a change in composition. Some highly precise instruments enable us to measure not only the degree of change in composition, but also the change in energy which takes place when substances react chemically. For many reactions, the changes which occur in energy and composition during these reactions are similar. After observing many reactions, scientists begin to see a trend in properties and can develop generalizations about the nature of matter. Such generalization is the heart of chemistry.

To the beginning chemistry student, the first big problem is that of communication. When a chemical change does occur, what is a simple way of writing down this information so that it will form a record which can be understood by other chemists? Early chemists had the same problem. To make communication easier, the chemical elements, the building blocks of all matter, were assigned symbols so they could be referred to in a shorthand form. It was found that elements, in various ratios, interact to form new compounds which in turn react with other compounds to form still other compounds. A chemical equation represents a chemical reaction and indicates the substances which react and the new substances that are formed. For the equation to be completely correct it must be balanced. "Balanced" means that it has the correct coefficients. There must be the same number of each kind of atom (represented by a symbol) on both sides of the equation. For example, when iron rusts it combines with oxygen to form a new compound which is mostly Fe_2O_3. The chemical equation for this reaction would be:

$$4Fe + 3O_2 \rightarrow 2Fe_2O_3$$

Objective

In this experiment, you will work with three classes of chemical reactions — displacement, decomposition, and synthesis. You will attempt to identify some of the products and write balanced chemical equations for each reaction.

Equipment

2 large test tubes	glass tubing	flame spreader
clay triangle	crucible	wooden splints

Procedure

A. Synthesis

1. Obtain a piece of magnesium about 13 cm long and roll it into a loose ball.
2. Place the Mg in a clean crucible and measure the mass of the crucible and its contents carefully to the nearest 0.01 g. Record the mass.
3. Place the crucible in a clay triangle, and place the clay triangle on a ring stand, as shown in Experiment 4, Figure 4-2, page 26.
4. Begin heating, slowly at first. Slowly increase the intensity of heat to the hottest flame of your laboratory burner. **CAUTION:** *The Mg may begin to burn. If it does burn, do not look directly into the flame.*

5. When the reaction is complete, stop heating. After the crucible has cooled slightly, remove it from the clay triangle with forceps. Measure the mass, then empty the crucible's contents into an evaporating dish.
6. Examine the contents for a change in composition. Add a few drops of water to the residue and try to detect the odor of ammonia (NH_3) gas. What does this suggest? (Hint: Is oxygen the only gas in air which will combine with Mg?
7. Compare the new mass with the original mass. If a reaction did occur, with what did the magnesium react?

Do 1st.

B. Decomposition

1. From the stock glass tubing (provided by your teacher), use a triangular file to cut a piece of tubing about 15 cm long. Fire polish the ends and bend the glass tubing into a 90° angle. **CAUTION:** *Sharp glass and hot glass.* Your teacher may demonstrate the correct techniques for bending and fire polishing glass tubing. See the Laboratory Techniques in the front of this book.
2. Obtain two small spatulas full of $CuCO_3$ and place it in a large, dry test tube.
3. Insert the glass tube into a one-hole rubber stopper and insert the stopper in the test tube containing the $CuCO_3$. **CAUTION:** *Use a lubricant such as glycerol or water, and towels or some other hand protection. Work slowly. Do not force the tubing.*
4. Pour about 5 mL of lime water, $Ca(OH)_2(aq)$, into a small test tube. Place the end of the right angle glass tube in the limewater solution as shown in Figure 5-1.
5. Heat the tube containing the $CuCO_3$ while holding the end of the glass tube in the limewater solution. Continue heating until the bubbling has nearly stopped. A cloudy appearance in the $Ca(OH)_2$ indicates the presence of CO_2. Observe. Is there a change?
6. Let the test tube cool and empty the contents of both tubes.

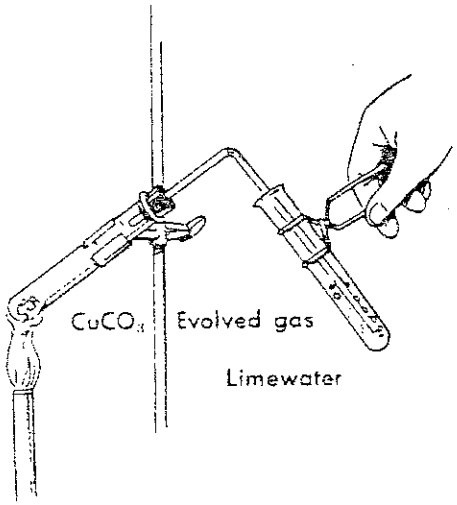

FIGURE 5-1. Testing for the presence of CO_2.

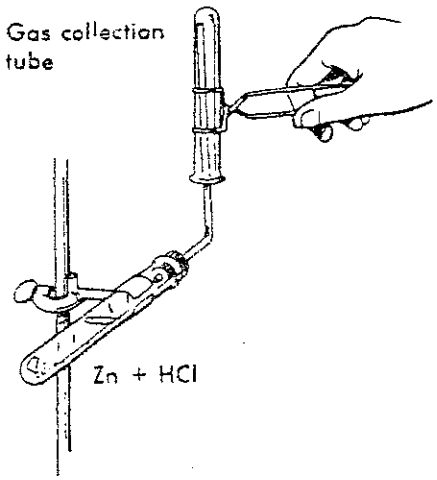

FIGURE 5-2. Collecting a gas by air displacement.

C. Displacement

Do 4th.

1. Use the apparatus used for Part B. Place a small piece of zinc in a test tube and add 5 mL of 6*M* HCl. Insert the rubber stopper containing the glass delivery tube. **CAUTION:** *Keep away from open flame.* Everyone must be done with A & B before starting.
2. A reaction should occur and a gas should escape from the tubing. With the glass tubing turned up, collect some of the gas being liberated. Collect the gas by displacement of air by inverting another test tube over the upturned gas delivery tube. See Figure 5-2.
3. Remove the test tube containing the gas from the glass tubing, keeping it inverted, and bring a burning splint near its mouth. A "pop" or "bark" indicates the presence of hydrogen gas.

D. Optional Demonstration

Do 3rd. (I demonstrate)

1. Obtain about 2 g of zinc dust and about 1 g of sulfur. Mix thoroughly. **CAUTION:** *Be careful not to grind or crush the material as a violent reaction can occur.*
2. Under a fume hood place the mixture on an asbestos square and ignite with a laboratory burner. **CAUTION:** *The reaction will be very rapid with a large amount of smoke.*

Results and Conclusions

1. Write the word equation for each reaction.
2. Write a chemical equation for each of the reactions. Be careful to include the correct formulas for all of the reactants and products. Balance the equations.
3. Indicate the type of chemical change which has occurred in each reaction.

Questions and Problems

1. How can you tell if a chemical reaction has occurred? What are some distinctive changes that can be observed? How do these changes differ from physical changes?
2. When magnesium is burned in air what products are formed?
3. In Part C, the test for hydrogen was the sound resulting when some of the gas exploded. Do any other gases have this characteristic? If so, name one.
4. Which of the reactions in this experiment was exothermic, and which was endothermic?

Name: Date:

Accelerated Chem: Take-Home Quiz

Show ALL work for credit!

My Metal is_____.

Write the formula and name for this metal carbonate._____ _____

Calculate its molecular mass. Is this the empirical formula? Explain why or why not?

Calculate the percent composition of the metal in the above compound.

Write a balanced decomposition reaction involving this metal carbonate.

Write a balanced composition reaction that produces your metal hydroxide.

Calculate the molecular mass of the metal hydroxide. Is this its empiricial formula? Explain why or why not.

Calculate the percent composition of the metal in the compound used above.

Write a balanced single replacement reaction involving your metal and some other metal compound.

Is your metal stronger or weaker than Hydrogen? Explain.

Write a balanced single replacement reaction involving your metal and HCl acid.

Write a double replacement reaction involving your metal.

Does this reaction occur? Explain why or why not.

Are there any ppt's in your products? Explain why or why not.

State 3 physical properties of your metal.

State 3 chemical properties of your metal.

State 3 primary uses of your metal or the metal within a compound.